The Prevalence of Cyanotoxins in Southern California Waterbodies

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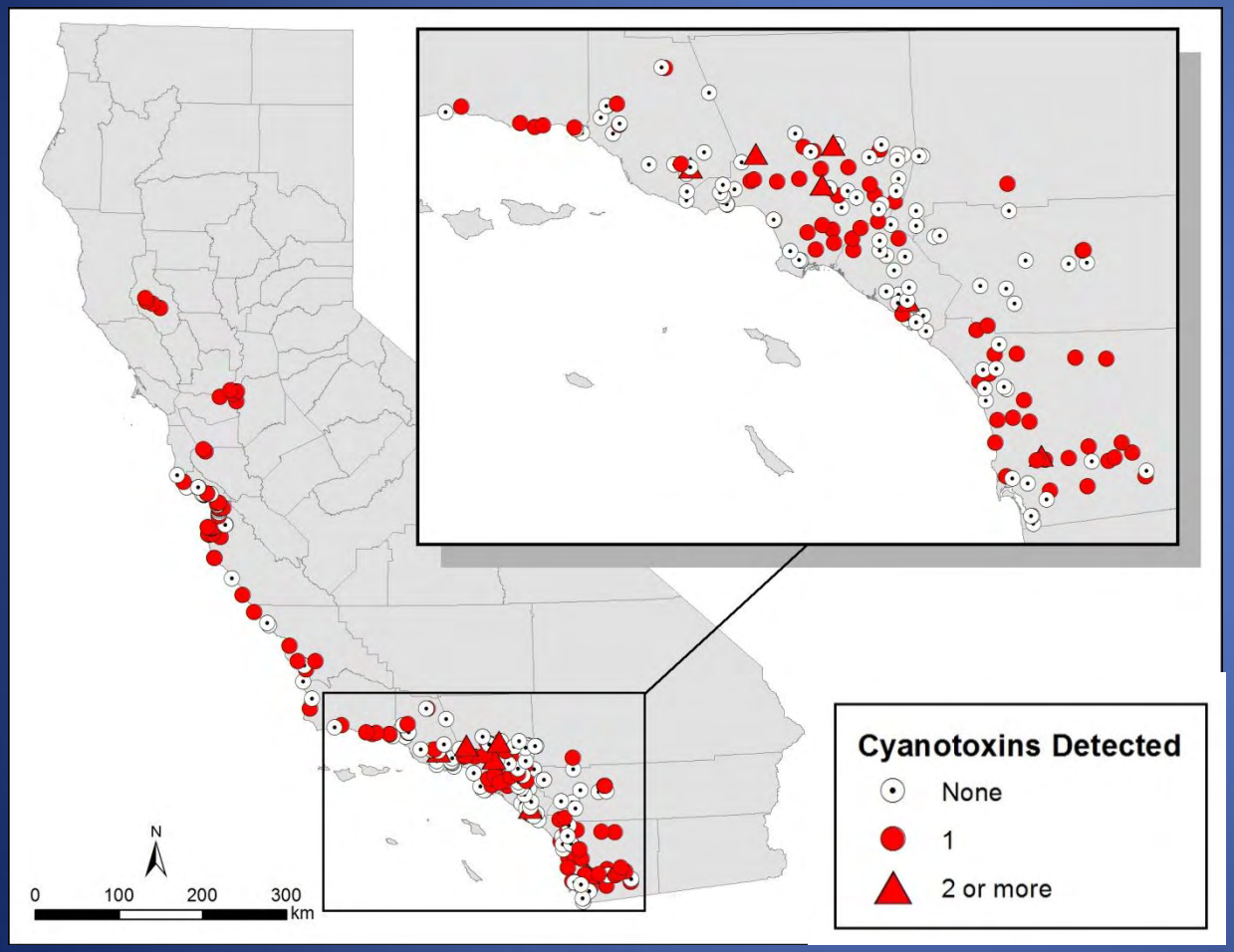
Microcystins Detected in California 2010-2012



UC Santa Cruz

SCCWRP

USGS

Coastal Confluences

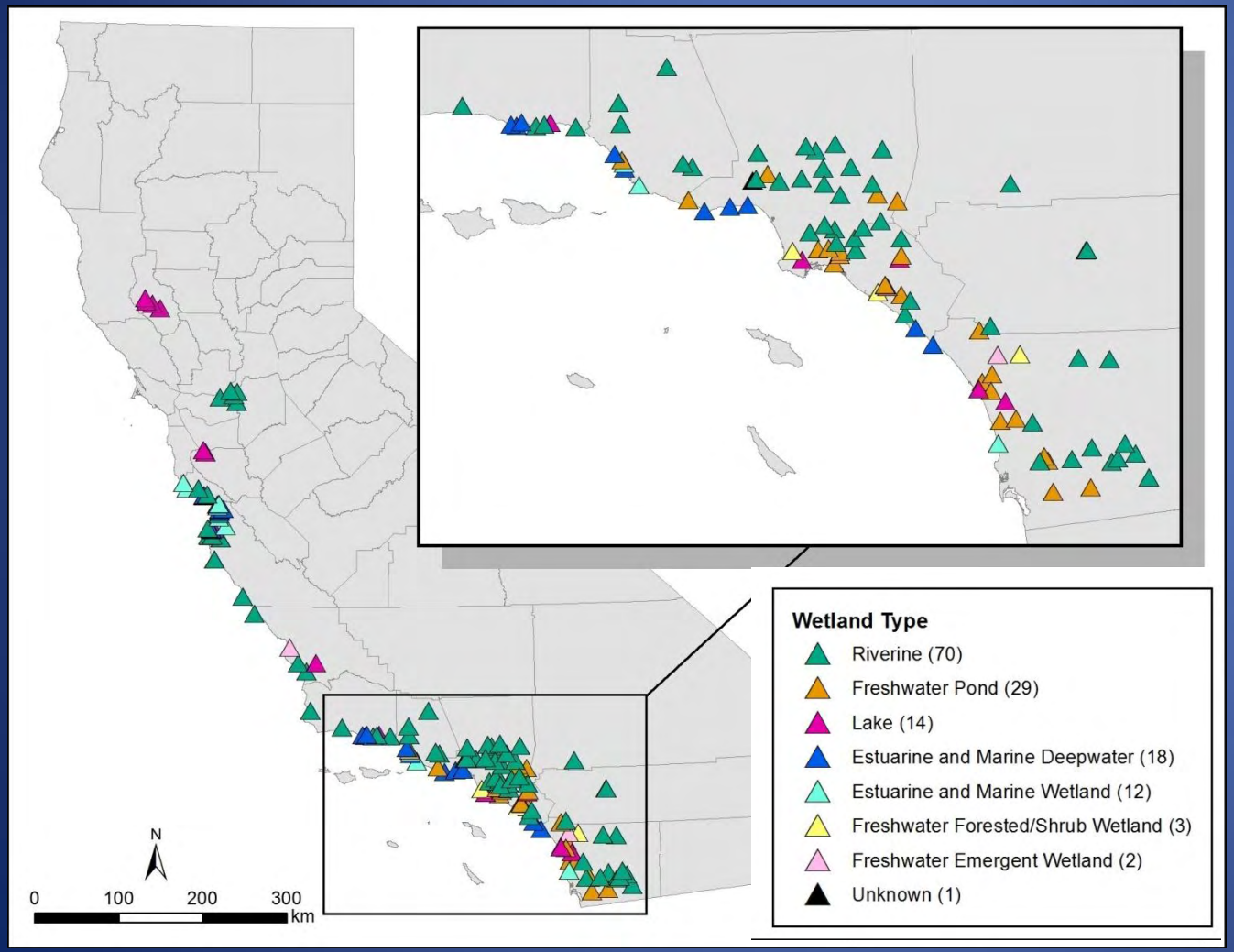
Regional Board 9

CalFED

Stormwater Monitoring Coalition

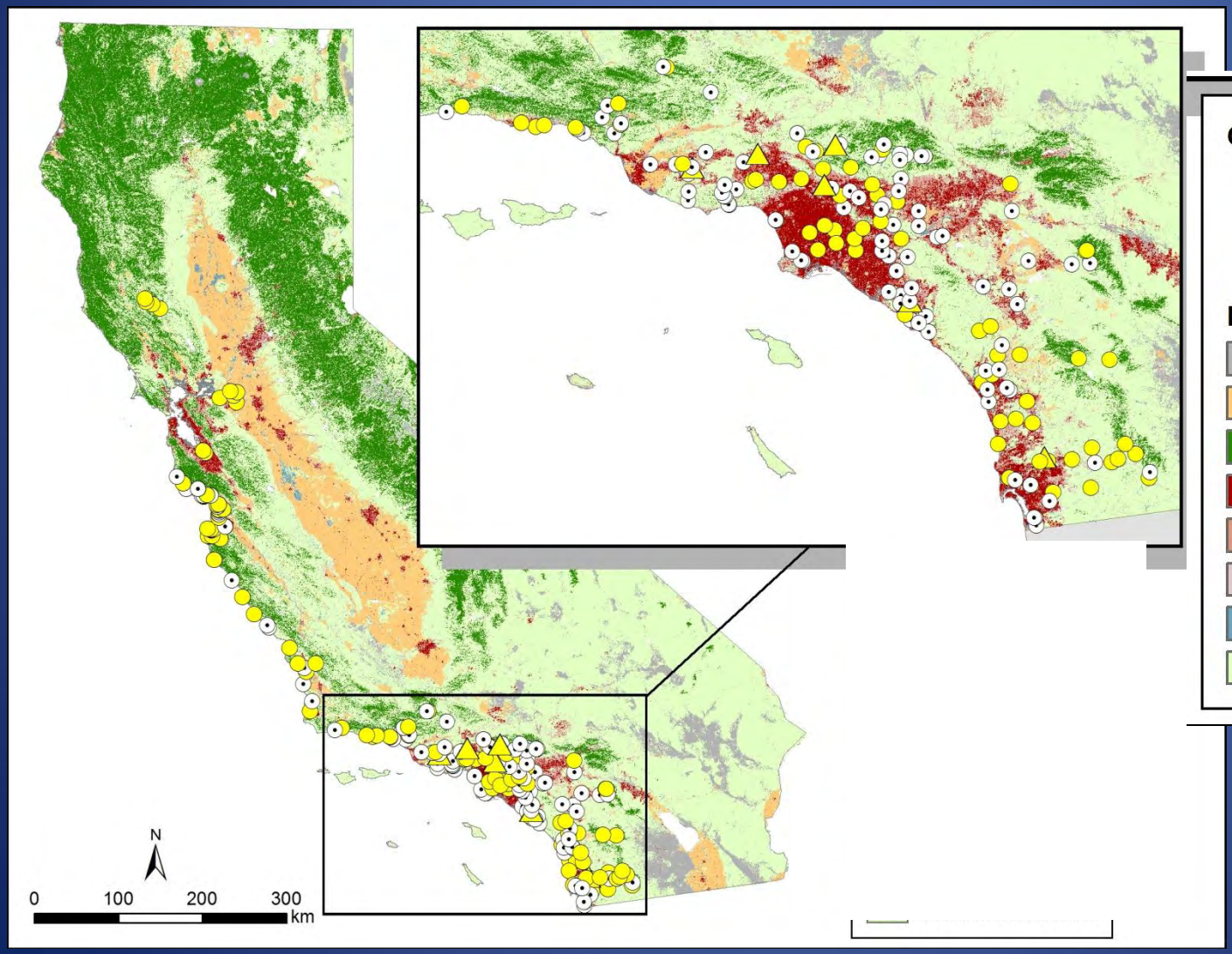
- Other Cyanotoxins detected
  - Anatoxin-a
  - Cylindrospermopsin
  - Lyngbyatoxin
  - Saxitoxin

Microcystins Detected In a Variety of Waterbodies



- Wetlands
- Lagoons
- Lakes
- Ponds
- Streams
- Rivers
- Estuaries
- Seawater

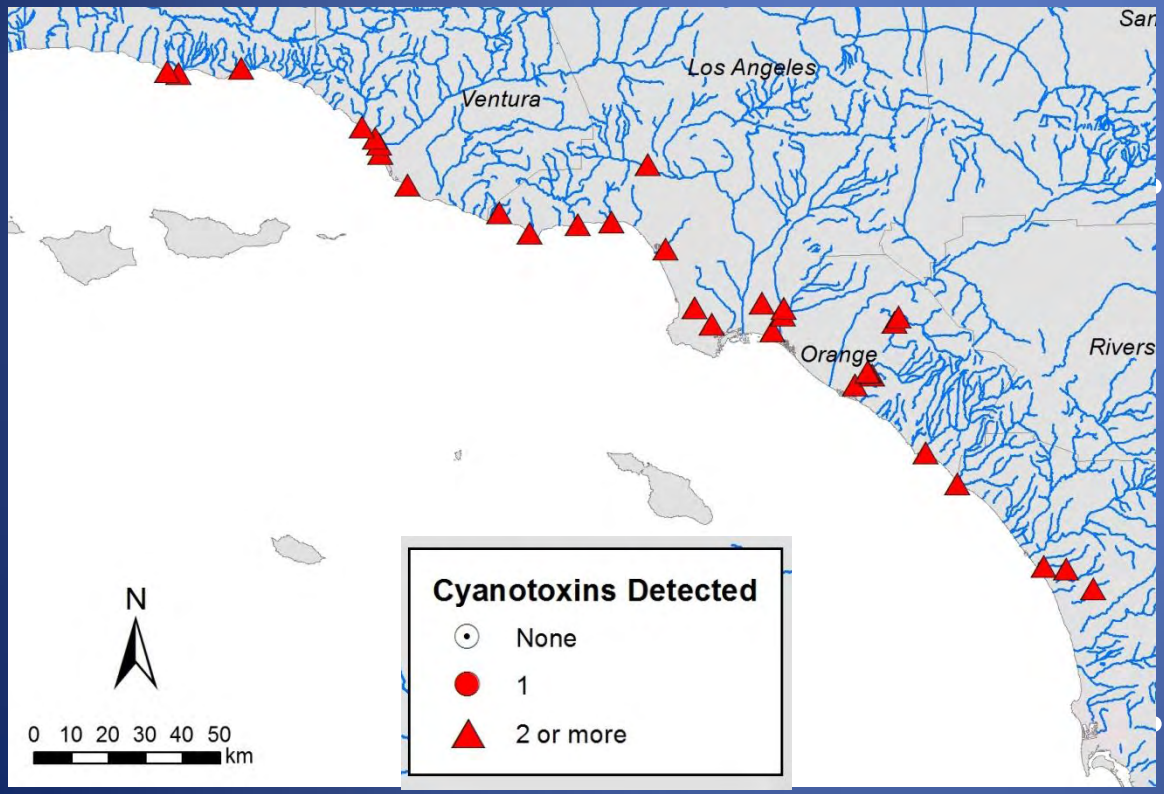
Microcystins Detected Across Many Land Use Types



Cyanotoxins: Considered to be "Contaminants of Emerging Concern"

- Dedicated session held at 2012 national meeting of Society of Environmental Toxicology & Chemistry (SETAC)
- Special cyanotoxins issue under consideration in *Environmental Toxicology*

Multiple Cyanotoxins Detected in Coastal Waterbodies

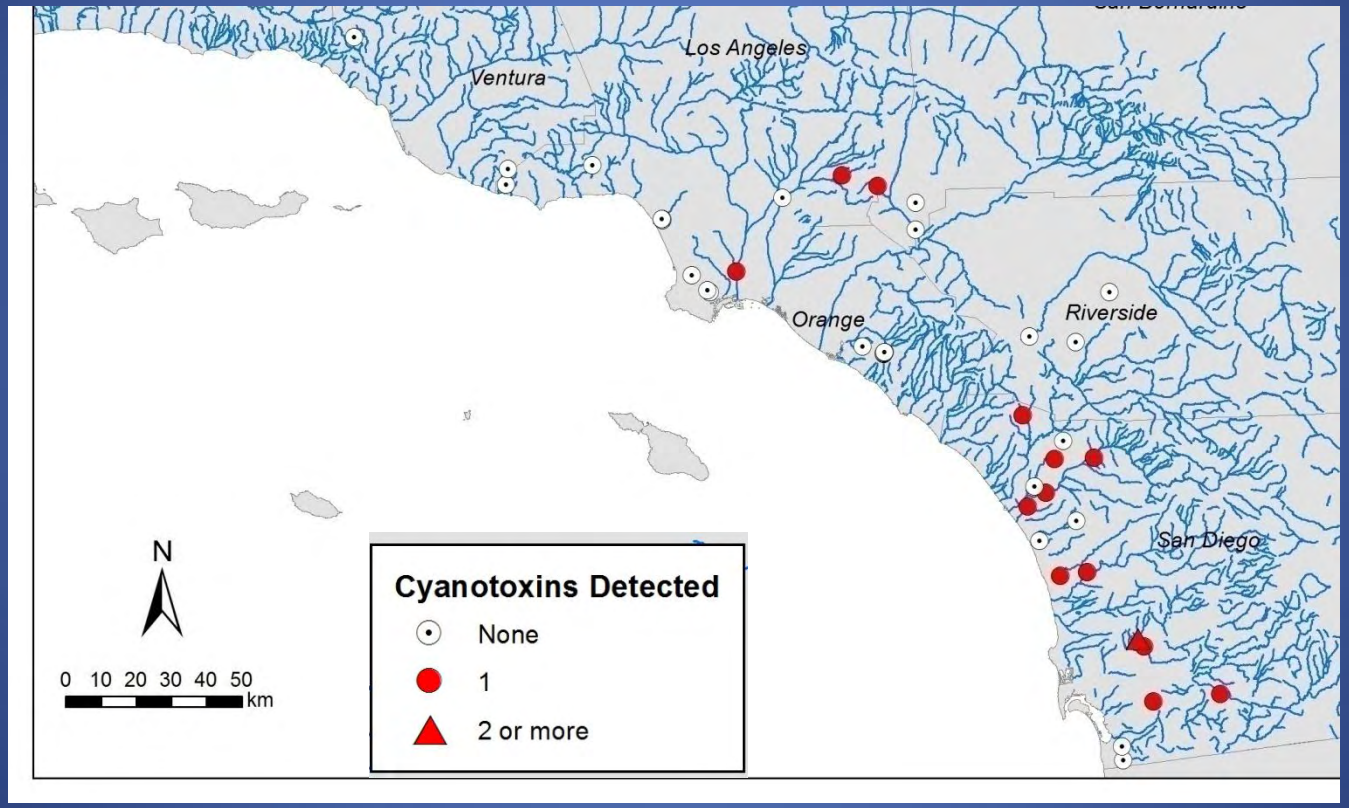


- Grab Samples Collected in August 2009

- ***100% samples positive for 3 cyanotoxins:***
  - Microcystins
  - Anatoxin-a
  - Cylindrospermopsin

- 3 Sites Exceeded CA Action Levels

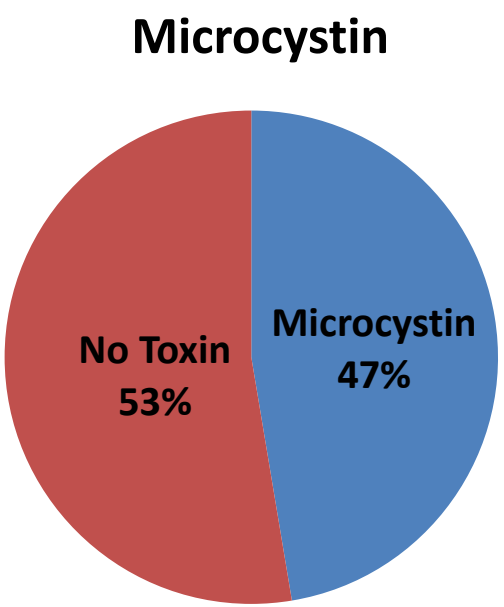
Cyanotoxins Detected in Depressional Wetlands

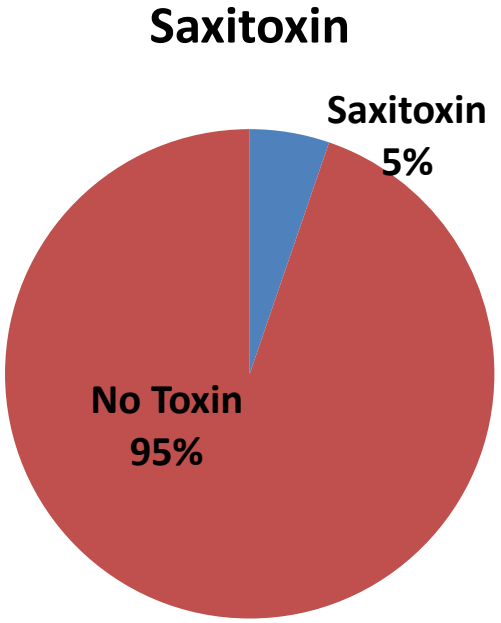


Probabilistic study that collected one time grab samples in Spring 2012

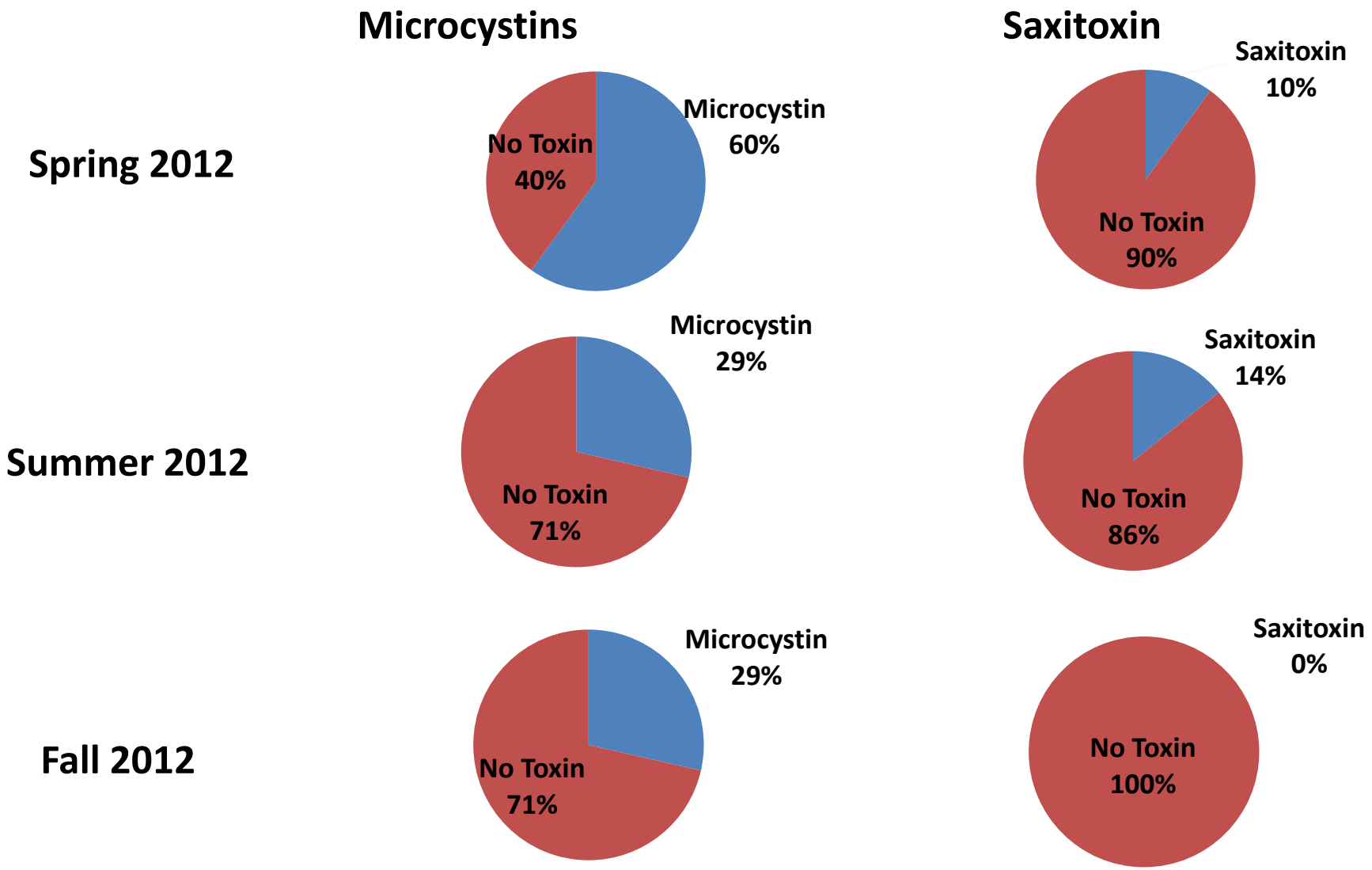
Percentage of Depressional Wetlands Sites Where Cyanotoxins Detected

Spring 2012

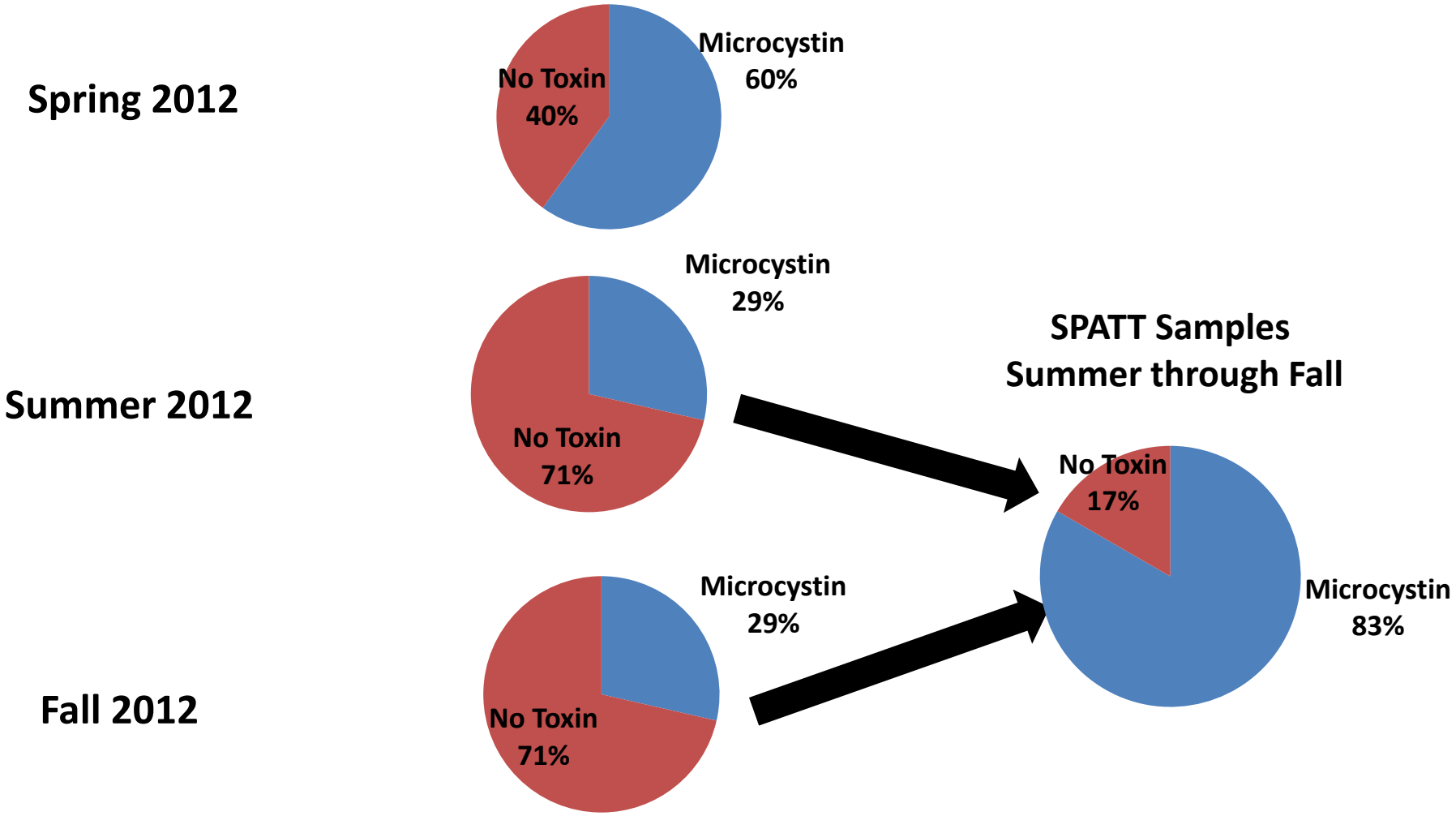




Expanded Study in San Diego Region: Toxin Results Across Multiple Seasons



San Diego: SPATT Results Show Double The Number of Sites With Toxin



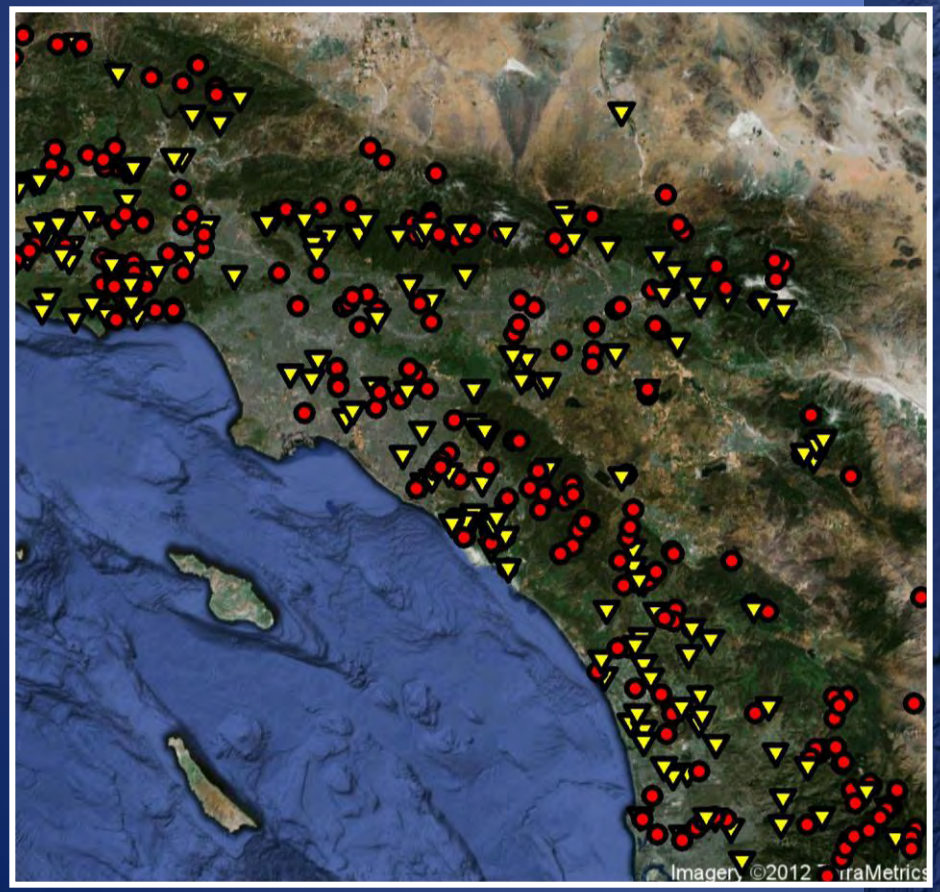
Cyanotoxins in Wadeable Streams

- Potentially important source of toxin loading
- Toxin production in streams may be exacerbated by increased heat & alterations to flow regimes:
  - Loss of riparian habitat for shading
  - Hydromodification; stagnation
  - “Perennialization” of intermittent streams by anthropogenic nuisance flows

Cyanotoxins in Wadeable Streams

- Cyanotoxins may help explain "mystery toxicity" in undeveloped catchments (*w/ atm. dep. of nutrients?*)
- Potential effects on food web, aquatic life uses
  - Some evidence (Spain) for cyanotoxin impacts to benthic macroinvertebrates (incl. EPT taxa)
  - Role in causal assessment (CA biological-objectives framework)
  - Biotic index interpretation

Locations of California stream bioassessment sites where benthic algae were sampled, 2007 - 2011 (N = 928 sites)



Sites where cyanobacterial genera known to have toxin-producing species were recorded

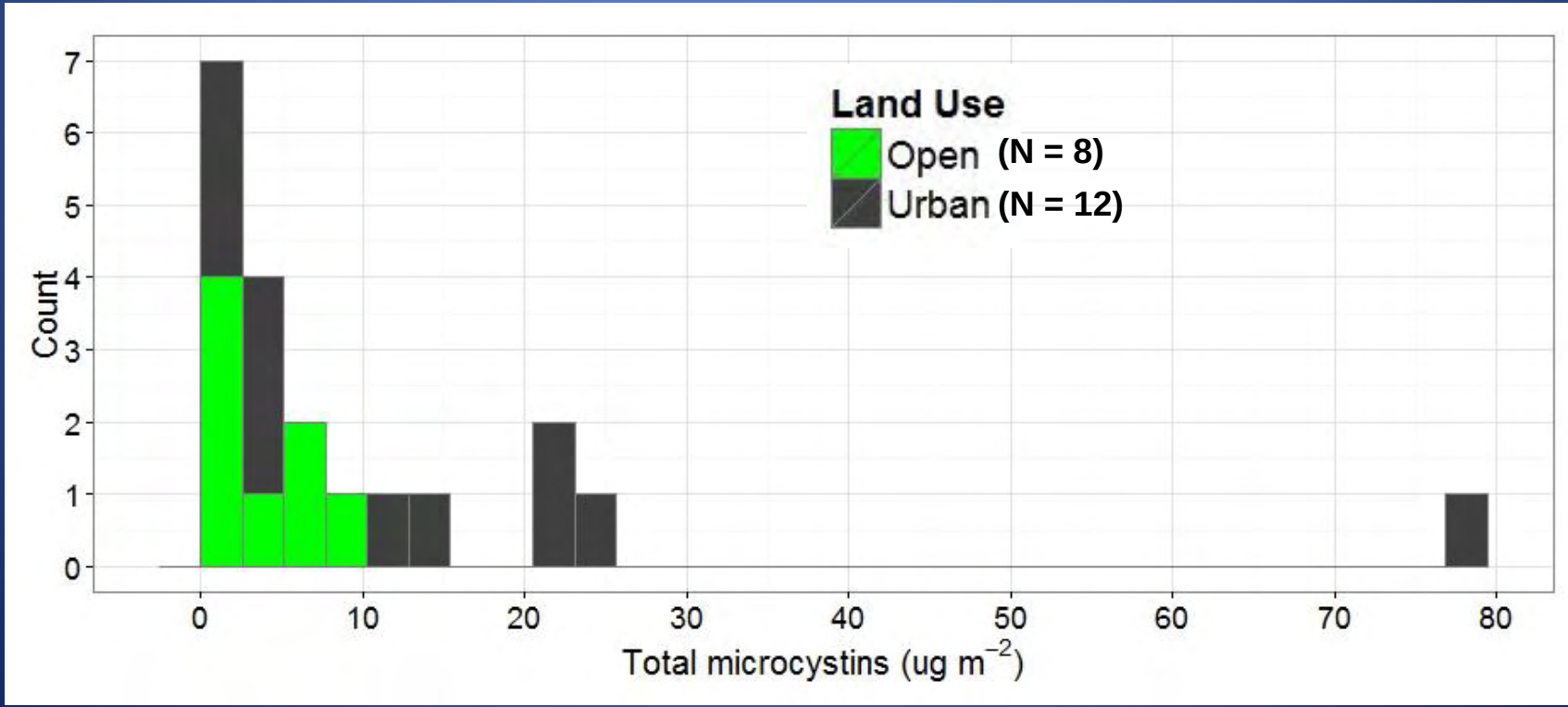
Sites where such taxa were not recorded

Methods: Stream Benthic Cyanotoxin Sampling

- Quantitatively scrape/brush biofilms from substrata & take cuttings from algal mats
- Homogenize into slurry
- Filter measured amount on glass-fiber filter; store frozen
- LC-MS/ELISA

Stream Pilot Study (MCY & ATX) – Yr 1

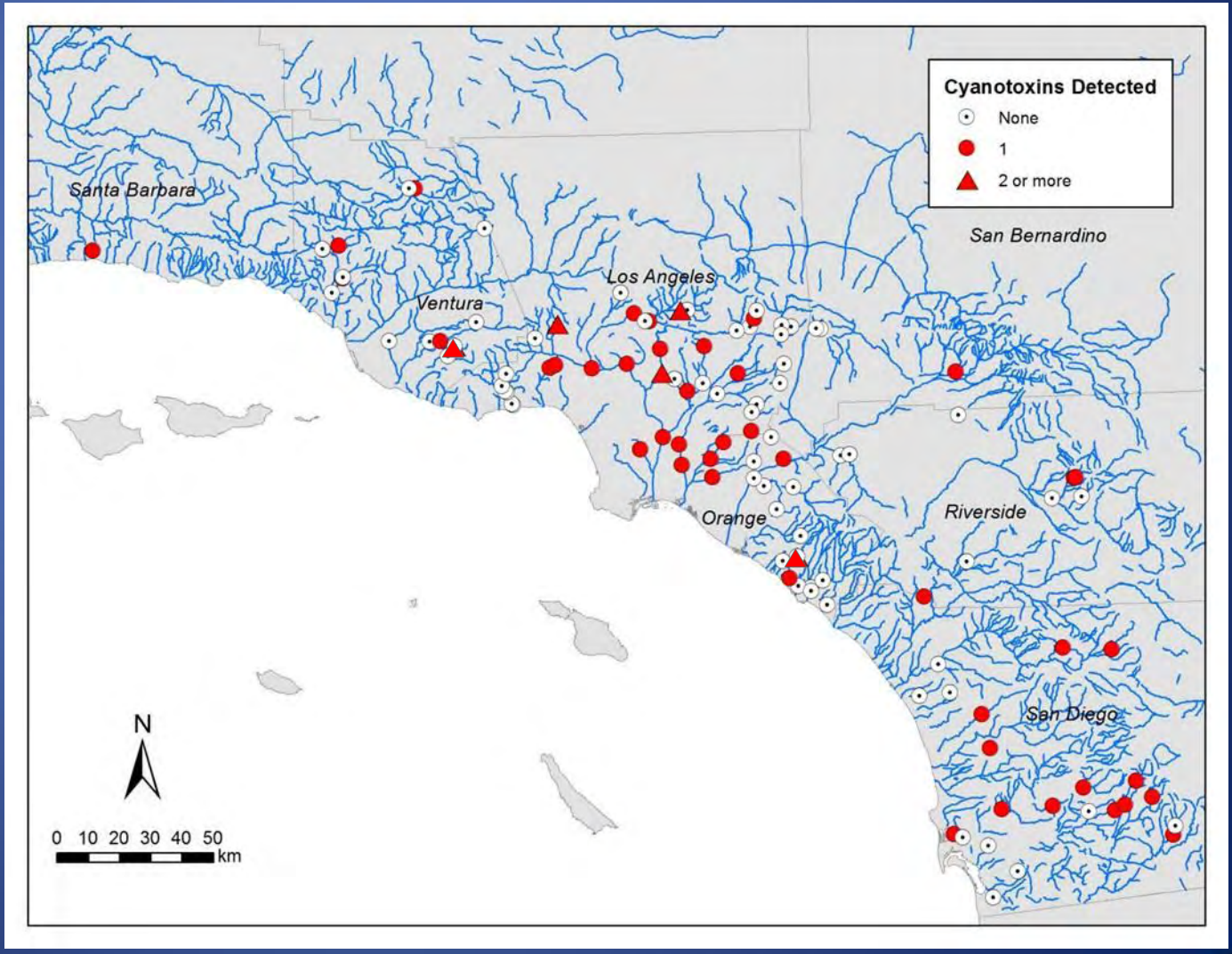
- LA/San Gabriel Rivers watersheds (N=20 samples)
- Microcystin hits at **75%** of urban sites, **57%** of open
- 4 microcystin congeners detected; no anatoxin-a



Multiple Cyanotoxins Analyzed & Detected in Streams – Yr 2

Cyanotoxins evaluated at the subset of sites with positive toxicity bioassay results:

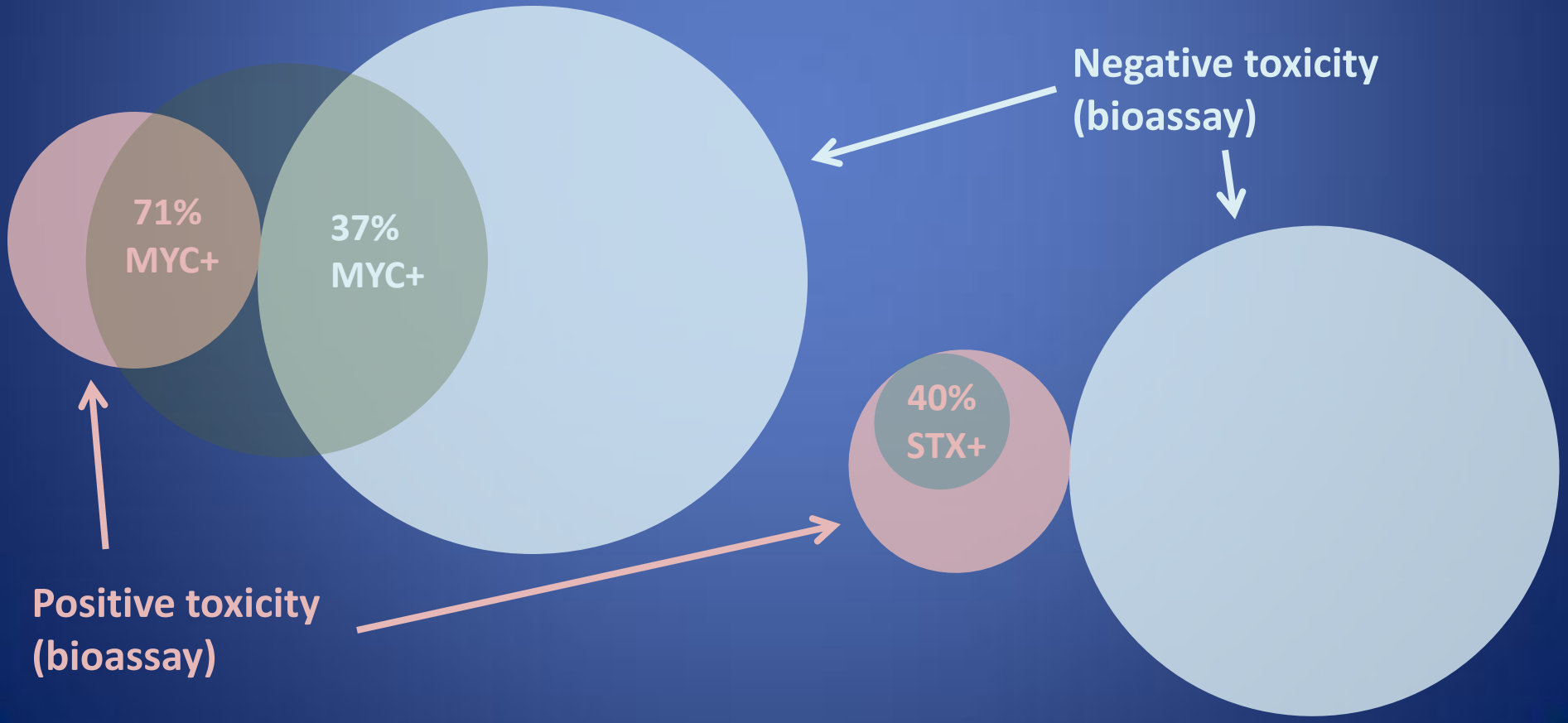
- **Microcystins**
- **Lyngbyatoxin**
- **Anatoxin-a**
- **Saxitoxin**
- Cylindrospermopsin
- Nodularin



Any Evidence for Relationship between Detection of Stream Benthic Cyanotoxins and Toxicity Bioassay Results?

Total Microcystins (N = 99 sites)

Saxitoxin (N = 81 sites)

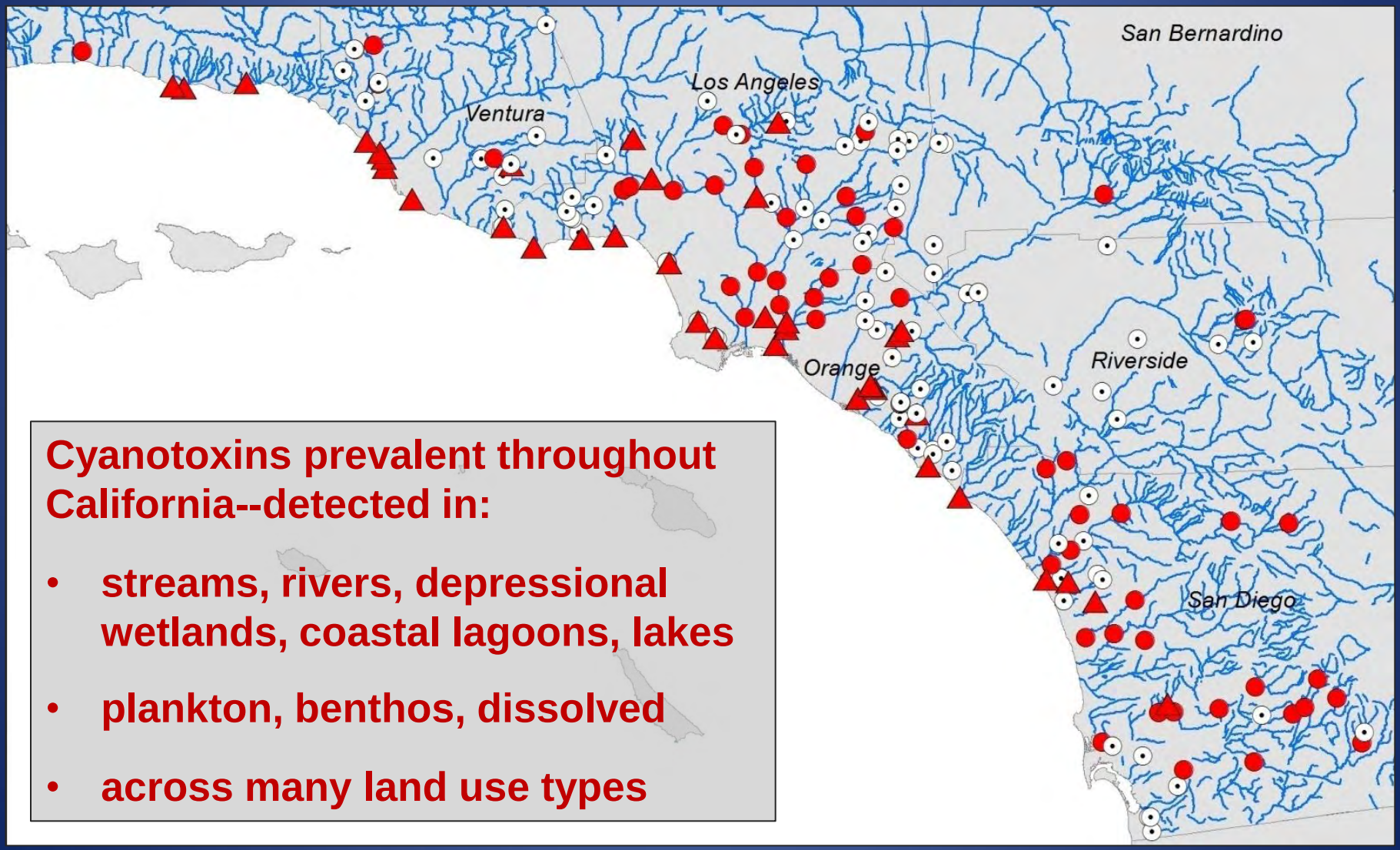


Summary of Yr 1 & 2 Stream Benthic Cyanotoxin Results

	Total microcystins	Lyngbya -toxin	Saxitoxin	Anatoxin	Cylindro-spermopsin	Nodularin
Sites tested	**MCY**	**LYNG**	**STX**	**ATX**	**CYL**	**NOD**
%	38	21*	5	3*	0	0
count	120	14	101	33	14	14

* Sites were preferentially selected for these additional cyanotoxin analyses based on positive results in toxicity bioassays.

Numerous & Varied Loading Sources for Cyanotoxins



Cyanotoxins prevalent throughout California--detected in:

- **streams, rivers, depressional wetlands, coastal lagoons, lakes**
- **plankton, benthos, dissolved**
- **across many land use types**

Acknowledgements

- Stormwater Monitoring Coalition crews (ABC Labs., Weston, AMEC, CSULB, Cal DFG)
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- UC Santa Cruz (Kendra Hayashi)
- US Geological Survey